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PATENT DISCLOSURE **DE 41 13 248 A1**

AIR INTAKE SYSTEM FOR OTTO INTERNAL COMBUSTION ENGINES

An air intake system for Otto internal combustion engines has a part-load air metering device for a controllable main intake support located in the bypass, which is provided with a downstream noise damping device. In order to obtain an easy to construct, maintenance-free noise-absorbing device that is without any repercussions for the controlled metering device, a configuration was proposed for the device that would divide the partial-load airflow determined by the metering element into partial flows of relatively slower speeds than the outflow speeds of each partial-load airflow coming from the metering device.

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DESCRIPTION

The invention concerns an air intake system for Otto internal combustion engines according to the generic terms of the characteristics described in claim 1.

The controlled intake air metering known for Otto internal combustion engines in the low partial load--in particular at idle speed—leads, with increasing displacement volume of the internal combustion engines with single metering element or idle-speed actuator (regulator), in each air intake unit, at generally closed main intake throttle, to an air metering extending far into the medium partial-load or driving range. In this actual

medium driving range, the given partial-load airflow comes at a relatively high speed from the metering element and enters in sections of the air intake unit. Hereby, the high airflow speeds have a disadvantageous acoustic effect. At the current state-of-technology, the unpleasant noise development, especially in the case of plastic air intake systems, is counteracted by the placement of a sound-absorbing device downstream of the metering element for the partial-load airflow.

The noise-deadening devices known for that are designed as an absorption damper made with an absorbing material. Such devices constitute, on the one hand, a not insignificant additional construction and cost increase. On the other hand, they have a functional repercussion on the control behavior of a metering element or idle-speed actuator through the increasing soiling of the absorption material in the absorption damper over the course time.

The task of the invention is to propose a maintenance-free, simple-to-construct, and therefore cost effective noise-absorbing device for an air intake system of the kind shown here.

This objective is achieved, according to the characteristic portion of claim 1, by a device that divides the partial-load flow determined by the metering element into partial flows slower in speed than each partial-load airflow from the metering element.

The advantage of the invention is that by dividing each partial-load flow into slower-speed partial airflows, a vibration excitation of the adjoining sections of the air intake unit causing noise radiation is avoided, whereby the sound-damping device, formed solely by a certain number of mechanical flow distributors, is maintenance free and easy to construct.

A preferred configuration of the invention for a simple construction includes a chamber placed downstream of the metering device with a minimum volume suitable to hold the greatest possible partial-load air flow per second, whereby the air from the chamber flows off through ports contained in a delimitation whose overall cross section is clearly greater than the outflow cross section of the metering element. Due to the absence of noise-absorbing components, the device according to the invention made of mechanical flow separators (dividers) is not only maintenance-free but in an additional advantageous manner also free of repercussions for the controlled metering element or the controlled idle-speed actuator (governor). The result is increased operating safety with high control quality of the metering element or idle-speed actuator.

In a further implementation mode of the invention, a layout of the device according to the invention is achieved, without needing any more mounting space, in that the metering element and the main intake support are placed in a flange closing a connecting opening of an air collector, and that the flange on the air collector side has an indentation in the adjoining peripheral area of the support forming a chamber for supplying air to the metering element connected on the downstream side, to which is attached, on the air-collecting side, a delimitation with holes. Preferred designs of the separate chamber delimitation containing holes in the form of intermediate layers or lids advantageously provide--for an engine series with different displacements--a simple acoustic fitting of the device through the use of intermediate layers (spacers) or lids with holes differing in cross section and configuration.

The separate chamber delimitation further allows an optimal placement and formation of the holes in order to obtain the noise absorbing effect through slow-speed

partial flows. Advantageously, with the help of an area without holes, the entire partial-load airflow streaming from the metering element at a relatively high speed can be divided into two chamber flows, which--a further advantageous configuration--flow off through holes diametrically arranged in groups. In a space of the air intake unit directly adjoining the intermediate layer (spacer), this layout produces two basically parallel airflows, which, for example, enhance a uniform supply to air-intake pipes diametrically connected to an air collector. For this, the groups' overall cross sections resulting from the holes can vary in size. Furthermore, with somewhat similar group cross sections, different penetrations in terms of cross sections can be provided, whose partial flows serve a further reduction relative to the various speeds through interferences.

Finally, the holes in the intermediate layer (spacer) can be provided through punching and be provided either with or without guide surfaces, whereby a guide surface has the purpose of aligning a partial flow in a certain direction. Furthermore, the speed reduction of the partial flows used to reduce the noise level can also be obtained by means of penetrations designed for a diffuser-like throughput. Finally, in the case of a large intermediate layer (spacer) between the flange of the main intake support and the connecting opening of the air collector, this intermediate layer (spacer) can be made of a material naturally high in Eigen absorption by attaching it only in the peripheral area.

The invention will be described based on the implementation examples shown in the figures.

Shown are in:

- **Figure 1:** a sound-absorption device according to the invention with an intermediate chamber delimitation; and
- **Figure 2:** an additional sound-absorption device with a chamber delimitation designed as a lid.

An air intake unit **1** shown only in sections, for an Otto internal combustion engine (not shown) includes an air collector **2** with diametrically adjoining intake pipes **3** and **4**. The air collector **2** has a collection opening **5** for a main intake support **6**, which can be connected to the air collector **2** via a flange **7**. The main intake support **6** is provided with a throttle valve **8**. A partial-load airflow-metering element **9** is placed in the bypass to this throttle valve **8**. The metering element **9** designed as a controlled idle-speed actuator, has, on the air collector side, an outflow cross-section **10** for the respective partial-load airflow. Furthermore, on the air-collector side, an indentation **11** is situated in the flange **7** near the peripheral area of the support **6**; it functions as an air-guiding chamber **12** connected to the metering element **9** on the downstream side. Per **Figure 1**, a separate delimitation **13** forming an intermediate layer **14** with holes **15** and **16**, situated between the flange **7** and the air collector **2**, is used to cover the chamber **12** that is open on one side.

The chamber **12**, connected downstream of the metering element **9** with its outflow cross section **10** of a volume corresponding at least to a maximum partial-load airflow per second, serves with its penetrations **15** and **16**, whose total cross section corresponds to at least 1.5 times the outflow cross section **10** of the metering element **9** as a sound-absorbing device **17**.

The sound-absorbing device **17** acts as a mechanical flow distributor in such a way that the given partial-load airflow, determined by the metering element **9** by means of openings **15** and **16**, is divided into partial flows with relatively low speeds compared to the speed of partial-load airflows flowing from the metering element or the idle-speed controller **9**. Because of the clearly greater overall cross section of all the openings **15** and **16** compared to the outflow cross section **10** of the metering element **9**, partial flows of such low speeds are obtained that an acoustic excitation of the air intake unit **1**, especially of the air collector **2**, is prevented.

As **Figure 1** shows, the intermediate layer (spacer) **14** is located in an area opposite to the outflow cross section **10** of the metering element **9** that contains no holes **15** and **16**, by which the entire partial-load airflow from the outflow cross section **10** is divided into partial flows A and B.

The figure shows further that the openings **15** and **16**--corresponding to the intake pipes **2** and **3** diametrically feeding into the air collector **2**--are placed in the intermediate layer (spacer) **14** in groups **18** and **19** diametrically distributed over the peripheral area of the main intake support **6**. The result is a homogeneous supply of both rows of intake pipes **3** and **4**. Depending on the need, the above-mentioned distribution, and a possible mutual effect through interferences, the cross sections of openings **15** and **16** of groups **18** and **19** can vary. To that end, either all the cross sections of groups **18** and **19** resulting from openings **15** and **16** can vary in size or, at similar group cross sections, the cross sections of openings **15** and **16** can be different. An especially simple configuration of the intermediate layer (spacer) **14** used as separate chamber delimitation **13** can be obtained through punched holes **15**, **16**. To

influence the direction of the partial flows from the openings **16**, they can also be provided with lead surfaces **20**.

Furthermore, it is possible to design the openings as diffuser-like throughput. Finally, the intermediate layer (spacer) **14** used as separate delimitation **13** can be made of a sealing material or a soundproofing material.

In the implementation example of **Figure 2**, the separate delimitation **13** to cover the on one side open chamber **12** is a lid **20**, forming a single unit with the flange **7**, of the sound-absorbing device **17** otherwise identical to that of figure 1. The lid **20** fitted in the peripheral contour of chamber **12** can be attached or loose.

Furthermore it is possible to place the chamber **12** with a delimitation **13** containing openings **15** and **16** in a separate intermediate piece (not shown) situated between the air collector **2** and a flange **7**--with or without the groove **11**--of the main intake support **6**.

The invention proposes the placement of a maintenance-free, easy-to-construct and compact noise-absorbing device **17** downstream of the metering element or the controlled idle-speed actuator **9**.

PATENT CLAIMS

1. Air intake unit for Otto internal combustion engines
   - with a partial-load air metering device (idle-speed actuator **9**) attached to a controllable main intake support (**6**) in the bypass, and
   - a sound-absorbing device (**17**) placed downstream of the metering element, **characterized in that**

- each of the partial-load airflows determined by the metering device (**9**) is divided by device (**17**) into partial flows with lower outflow speed compared to that of the partial-load airflow flowing from the metering element (**9**).

2. Air intake unit per claim 1, characterized in that
   - the device (**17**) includes a chamber (**12**) located downstream of the metering element (**9**) with a minimum volume corresponding to holding a time-related maximum partial-load airflow; and that
   - the chamber (**12**) also has a delimitation (**13**) containing openings (**15, 16**); whereby
   - the total cross section (F_{ges}) of the openings (**15, 16**) corresponds to at least 1.5 times the outflow cross section (**10**) of the metering element (**9**).
3. Air intake unit per claims 1 and 2, characterized in that
   - the metering element (**9**) and the main intake support (**6**) are located on a flange (**7**) closing a connecting opening (**5**) of an air collector (**2**); and that
   - the flange (**7**) on the air collector side has a groove (**11**) in the peripheral area of the support (**6**) forming an air-supplying chamber (**12**) that is connected to the metering element (**9**) on the downstream side, which
   - on the air collector side, is provided with a separate delimitation (**13**) containing openings (**15, 16**).

4. Air intake unit per claims 1 to 3, characterized in that the delimitation (**13**) is designed as an intermediate layer (spacer) (**14**) inserted between the flange (**7**) and the air collector (**2**).
5. Air intake unit as per claims 1 to 4, characterized in that the intermediate layer (spacer) (**14**) is located in an area without openings (**15, 16**) opposite to the downstream cross section (**10**) of the metering element (**9**).
6. Air intake system as per claims 1 to 5, characterized in that the openings (**15, 16**) are distributed in groups (**18, 19**) over the adjoining peripheral area of the main intake support (**6**) in correlation to intake pipes (**3, 4**) diametrically feeding into the air collector (**2**).
7. Air intake unit per claims 1 to 6, characterized in that all the cross sections of groups (**18, 19**) resulting from the openings (**15, 16**) either vary or that, at similar group cross sections, the penetrations (**16, 16**) are different.
8. Air intake unit per claims 1 to 7, characterized in that the openings (**15, 16**) are punched (stamped) and provided with or without lead surfaces (**20**).
9. Air intake unit per claims 1 to 7, characterized in that the openings are designed as diffuser-like passages.
10. Air intake unit per claims 1 to 9, characterized in that the intermediate layer (spacer) (**14**) serving as separate delimitation (**13**) is made of a sealing material or a soundproofing material.
11. Air intake unit per one or several of claims 1 to 10, characterized in that the separate delimitation (**13**) is a lid (**20**) of chamber (**12**) forming a single piece with the flange (**7**).

12. Air intake unit per one or several of claims 1 to 10, characterized in that the chamber (**12**) with a delimitation (**13**) containing openings (**15, 16**) can be placed in a separate intermediate piece between the air collector (**2**) and a flange of the main intake support (**6**).